Sustainable Groundwater Management Act

Madera Subbasin
Second Technical Workshop

1:00 p.m. to 4:00 p.m., June 25, 2018
Madera County

Madera, CA

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Meeting Objectives

- **Review of basin boundary water budget**
- **Projects and management actions**
  - Adjusting to GSP sustainability goals
  - Guidelines, policies, and considerations
- **GSA surface water system budgets**
  - Preliminary estimates and
  - Probable range of net recharge from surface water system

Agenda

- Sustainable Groundwater Management Act (SGMA) review
- Basin boundary water budget results review
- Projects and management actions
- Preliminary GSA water budget results
- Summary
- Next steps

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SGMA Overview: The Basics

- Applies to 127 medium and high priority groundwater basins in California—Madera is a critically overdrafted basin
- Requires Groundwater Sustainability Agencies (GSA) be formed by June 30, 2017—Madera has seven GSAs
- Requires GSA's managing critically overdrafted basins to adopt Groundwater Sustainability Plans (GSP) by January 31, 2020
- Requires "sustainable groundwater management" within 20 years of GSP adoption: by 2040 for all critically overdrafted basins

SGMA Overview: Definitions

- **Sustainable Groundwater Management.** The management and use of groundwater in a manner that can be maintained during the **planning and implementation horizon** without causing **undesirable results.**
- **Planning and implementation horizon.** A 50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its **sustainable yield.**

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SGMA Overview: Definitions

- **Sustainable Groundwater Management.**
  - Today through January 31, 2040
    - Implementation of plan to achieve sustainable groundwater management
  - February 1, 2040 through January 31, 2090
    - Sustainable groundwater management required
    - Undesirable results may NOT occur

SGMA Overview: Definitions

Undesirable result. One or more of the following effects caused by groundwater conditions occurring throughout the basin. Significant and unreasonable:

Chronic lowering of groundwater levels.

Reduction of groundwater storage

Degraded water quality, including the migration of contaminant plumes that impair water supplies

Land subsidence that substantially interferes with surface land uses

Sea Water intrusion

Depletions of interconnected surface water

SGMA Overview: Definitions

- **Sustainable yield**. The maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an **undesirable result**.
- **Minimum Threshold**. The numeric value for each sustainability indicator used to define undesirable results.
- **Measurable Objectives**. The specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin.

SGMA Overview: GSP Objective Retain Local Control of Groundwater

- Develop a set of projects and management actions that when fully implemented result in cost effective sustainable groundwater management for the Madera subbasin
- Develop a Groundwater Sustainability Plan (GSP) that is approved by
  - California Department of Water Resources (DWR)
  - California State Water Resources Control Board (SWRCB)

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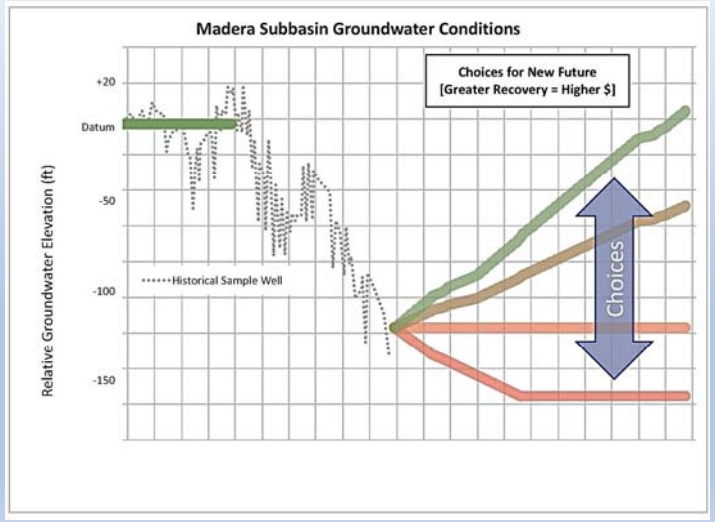
SGMA Overview: GSP Requirements

- Sustainable groundwater (GW) management over a period of years during which water supply conditions approximate average conditions
- No undesirable results in sustainability indicators
  - GW levels
  - GW storage
  - Sea water intrusion
  - GW quality
  - Land subsidence
  - Depletions of interconnected surface water
- No overdraft–over time, on average:
  - Groundwater storage does not decrease
  - Groundwater system inflows equal or exceed outflows

SGMA Overview: Key Goal



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June 25, 2018

11

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What is a Water Budget?

- A complete accounting of total groundwater and surface water entering and leaving a basin (the Madera Subbasin) including the changes in the amount of water stored over a specified period (1989 through 2014)
- Basic Accounting Principle:
  Inflow – Outflow ± Change in Storage = 0
- Just like your checking account:
  Deposits – Withdrawals ± Change in Balance = 0

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12

Water Budgets Required by SGMA

- Historical: 1989-2014 (26 years)
  - Tracks historic land uses
  - 1989-2014 climate and water supplies
  - Needed to calibrate GW model
- Current:
  - Assumes 2015 land use in every year 1989 through 2014
  - Applies 1989 through 2014 climate and water supplies
- Future: projected minimum of 50 years historical precipitation and climate, along with projected surface water inflows and outflows under a reasonably foreseeable future.

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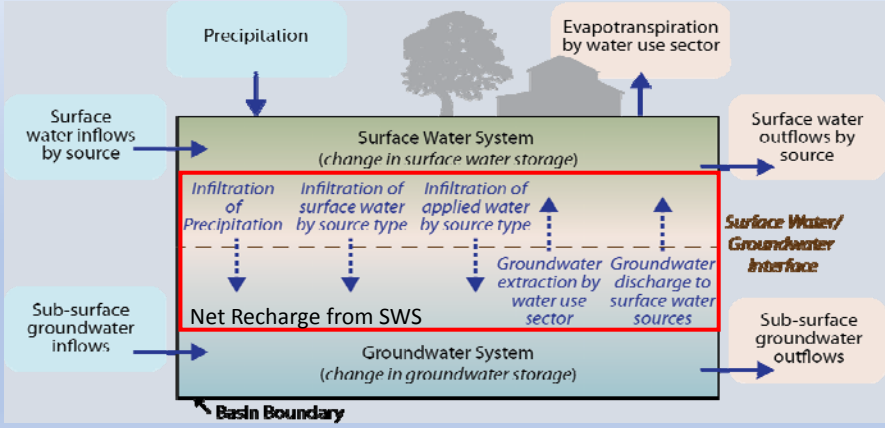
Water Budget: Net Recharge from SWS

Complexity of water budget varies depending on setting



Source: Water Budget BMP, December 2016

Water Budget: Net Recharge from SWS

- Measure of Surface Water System contribution to (or extraction from) the Groundwater System
- Zero or Positive value
  - Recharge greater than groundwater pumping
- Negative value
  - Recharge less than groundwater pumping
- Evaluation of subsurface inflows and outflows necessary to determine sustainability

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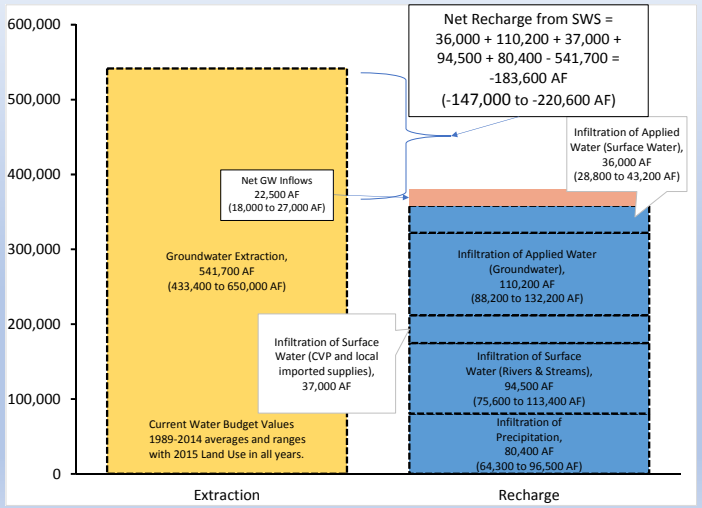
Current (2015 Land Use) Water Budget: Land Use and ET

Land Use	Area (acres)		Average ET, 1989-2014 (inches)		
	1989-2014 Averages	2015	ET_c	ET_pr	ET_aw
Almonds	38,300	75,006	41.6	7.1	34.5
Grapes	79,254	67,489	26.7	6.6	20
Pistachios	21,912	27,189	32.3	7.5	24.8
Grain and Hay Crops	7,878	9,118	7.7	7.7	0
Pasture and Alfalfa	15,942	7,581	38.6	7.5	31
Miscellaneous Truck Crops	2,714	7,480	30.4	5.2	25.2
Corn	7,405	6,963	34.3	5.6	28.7
Miscellaneous Deciduous	10,868	5,054	30.4	8.3	22.1
Citrus and Subtropical	6,534	4,512	40.3	7.6	32.7
Idle	11,709	4,198	6.5	6.5	0
Walnuts	1,018	1,157	33.9	7.2	26.7
Miscellaneous Field Crops	9,930	409	30.9	6.4	24.5
Total	213,464	216,158			

ET_c = Total crop ET, ET_pr = ET from precipitation, ET_aw = ET from applied water

Water Budget: Current (2015 Land Use) Preliminary Net Recharge from SWS



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17

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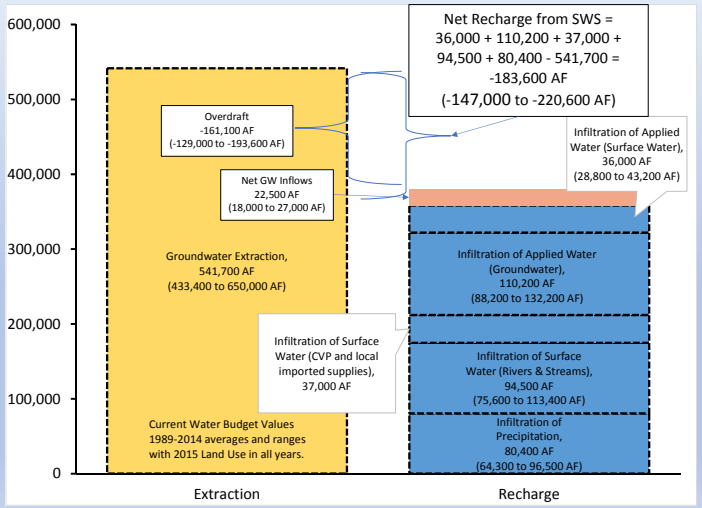
Water Budget: Current (2015 Land Use) Preliminary Overdraft Estimate



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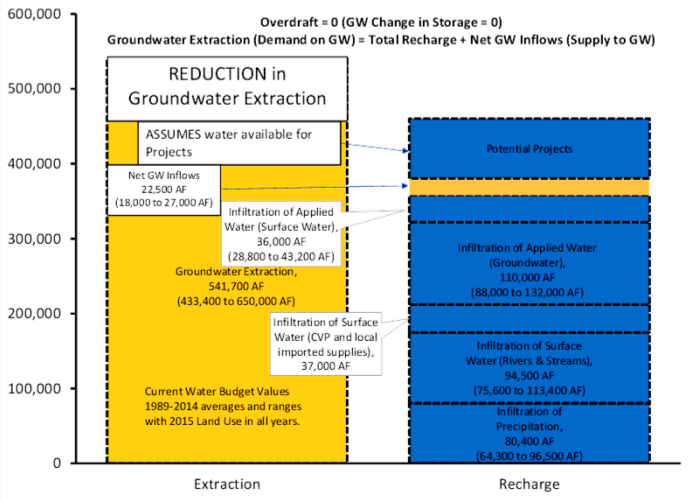
18

Projects and Management Actions: Mixture



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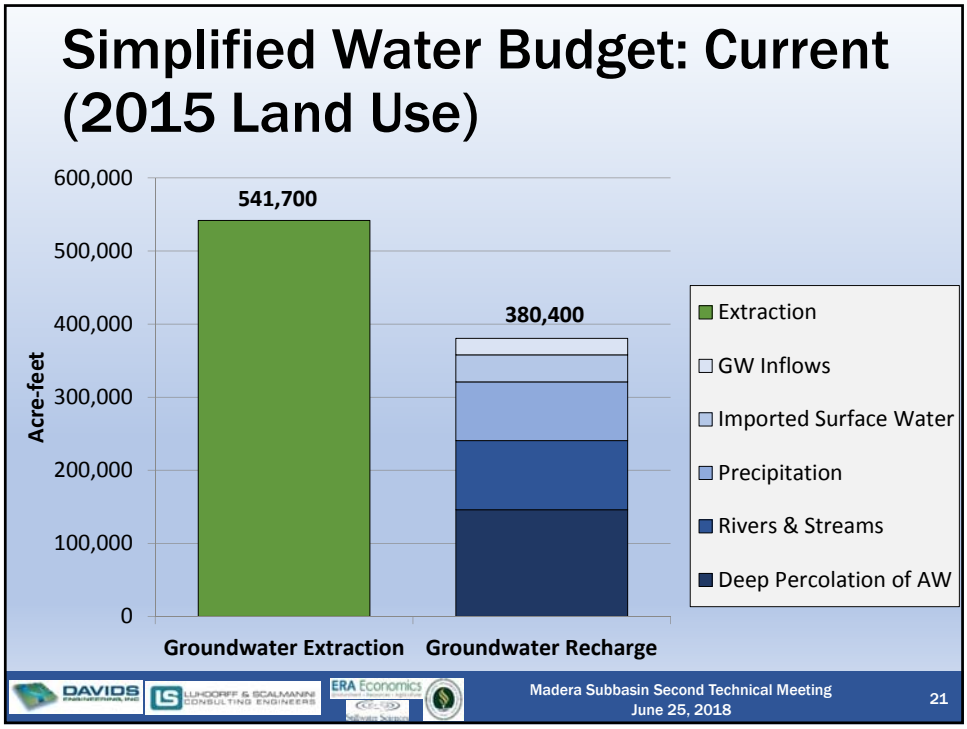
Projects and Management Actions

- Projects and management actions will be implemented to meet sustainability objectives
- Supply augmentation
  - Projects to better utilize existing supplies
  - Projects to generate new supplies
- Demand management
  - Incentives to facilitate trading
  - Incentives for on-farm practices
  - Incentives for land use change
- Identify least-cost and combination of projects and management actions, and establish feasibility


Simplified Water Budget: Current (2015 Land Use)
600,000
500,000
400,000
300,000
200,000
100,000
0
Acre-feet
541,700
380,400
Extraction
GW Inflows
Imported Surface Water
Precipitation
Rivers & Streams
Deep Percolation of AW
Groundwater Extraction
Groundwater Recharge
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June 25, 2018
21

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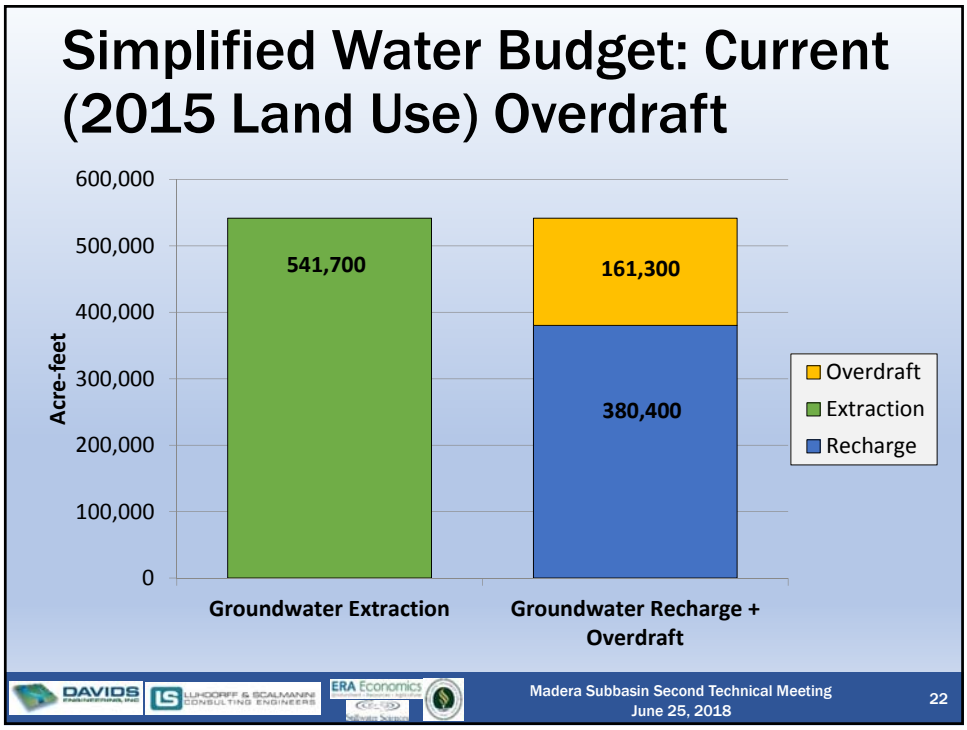
Simplified Water Budget: Current (2015 Land Use) Overdraft
600,000
500,000
400,000
300,000
200,000
100,000
0
Acre-feet
541,700
161,300
380,400
Overdraft
Extraction
Recharge
Groundwater Extraction
Groundwater Recharge + Overdraft
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June 25, 2018
22

Balancing the Water Account

- A combination of projects and management actions can be evaluated by considering costs, feasibility (technical and economic), and fairness
- GSAs and individual parcels may have different options available to them to balance the account
  - The distribution of costs and benefits from projects and management actions is not uniform across the subbasin

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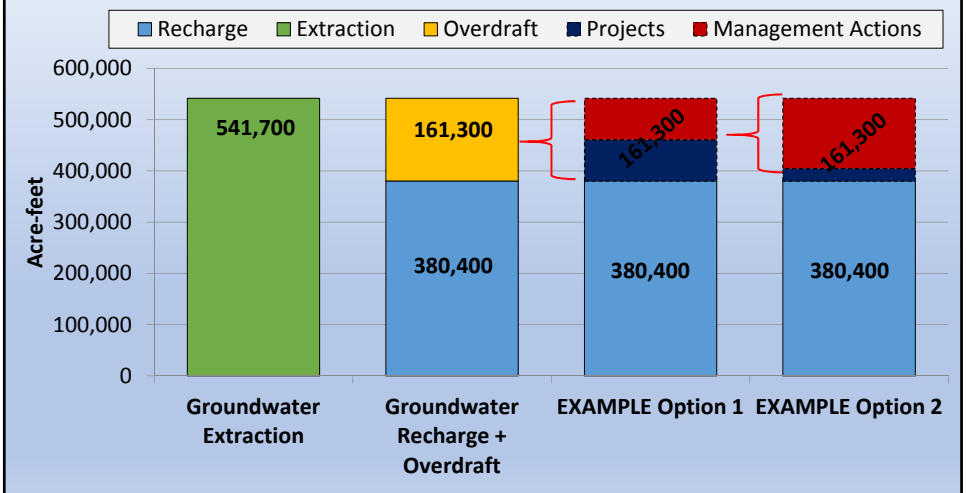
Comparing Options (EXAMPLES)



Meeting Sustainability Objectives

- Supply augmentation projects alone are unlikely to fill the gap
  - Limited potential projects
  - Questionable feasibility and timing
  - Affordability challenges
  - Increasing competition
- Demand management program to reduce groundwater extraction to fill the gap
  - Scale up or down, over time, depending on cost-effective supply augmentation projects
  - Ensure subbasin meets sustainable yield
    - One key GSP evaluation criteria (Article 6. § 355.4.b.(5))

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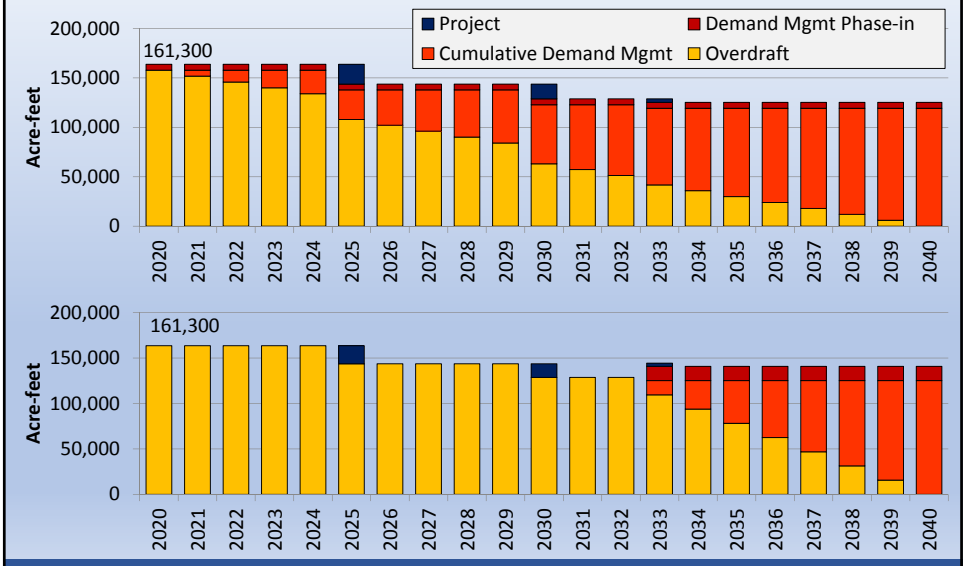
Demand Management Overview

- Administrative considerations
  - Define the sustainable yield of the basin
  - Decide how to measure groundwater use
  - Define baseline allotment
  - Define possible “phase-in” period
- Implementation
  - Options range from pumping limits (rigid) to full water market (flexible) – topic for next meeting
  - Consistent with undesirable results specified in GSP
- Operational considerations
  - Monitoring and enforcement
  - Cost allocation for program implementation
  - Flexibility to adjust over time and reduce costs

Example Implementation Choices



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June 25, 2018

27

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Evaluating Implementation Options

- How do we compare the costs and benefits of alternative transition paths?
  - Deferring a more gradual transition to sustainability results in lower costs
  - Key tradeoff: the longer you defer, the more rapid the adjustment
- Timing of projects and management actions
  - Projects may be implemented at a lower cost in specific GSAs
  - Timelines and project feasibility varies
  - Net yield of projects should account for subsurface flows
  - New data and information will become available
  - The subbasin must avoid undesirable results

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June 25, 2018

28

Groundwater Allotments: GSA Cooperative Decision

- What is an allotment?
  - An amount of the sustainable yield of the subbasin assigned to each GSA, to be determined among the GSAs
- Allotments can be defined in various ways:
  - Spatial factors such as recharge (across GSAs or individual parcels)
  - Hydrologic variability and undesirable results
  - Historical, current, and future investments
- Why are allotments important? Demand management requires:
  1. Determination of permissible pumping within the subbasin (per sustainability indicators)
  2. Allocation of permissible pumping
  3. Measurement to administer the allocations
  4. A trading mechanism

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Water Supply Allotments

- An initial step in developing a conceptual allotment is to define the different types of groundwater in the subbasin

Natural Recharge from:	Artificial Recharge from:	Other Considerations
Precipitation	Imported surface water	Projects
Rivers and streams	Managed storm water	Historical investment
	Dedicated facilities	Planned depletion of GW storage during phase-in
	Applied surface water	Minimum water requirements
	Applied groundwater	Subsurface flows
		Basin boundaries
		Undesirable results

Allotment Economic Considerations

- After defining water types, next step would be to agree to the allotment of water types by GSA
  - Allotment policies may differ by water type
  - Distribution of allotments affects the cost and acceptability of demand management
- The cost of demand management in any given GSA increases with:
  - The magnitude of the demand reduction
  - Increasing acreage planted to permanent crops using groundwater only
- A mechanism for allotments to be traded will reduce overall costs to buyers and sellers

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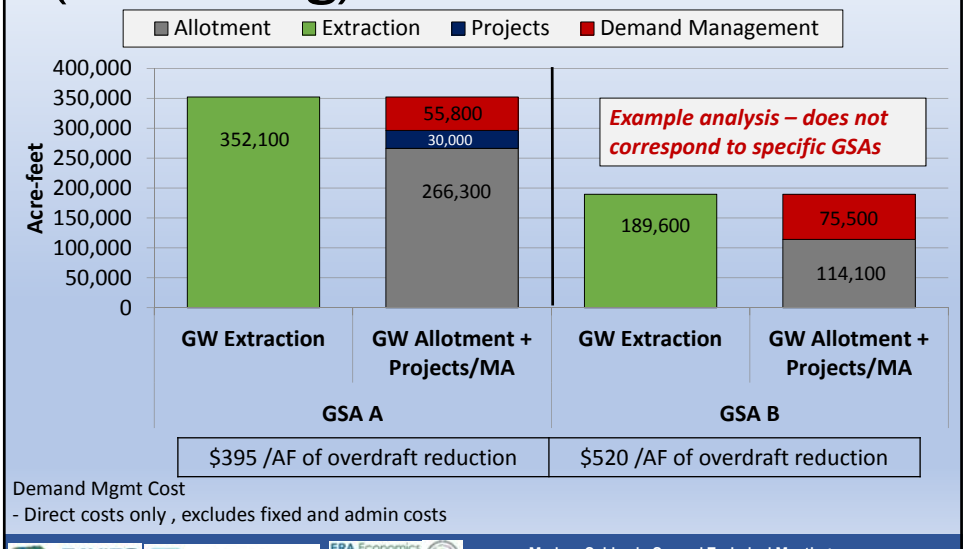
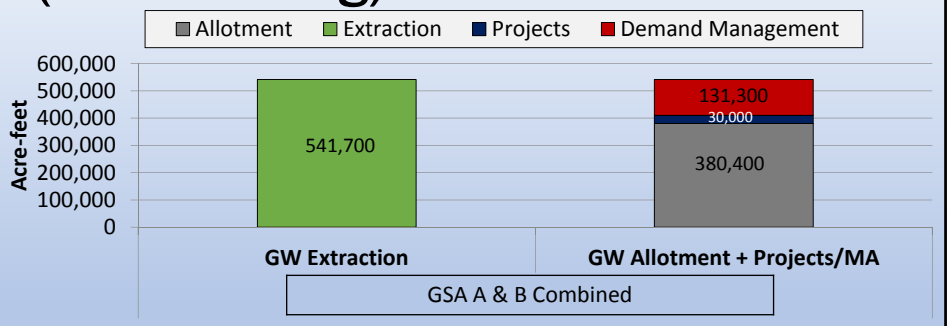
Example Implementation Costs (No Trading)



Demand Mgmt Cost
- Direct costs only , excludes fixed and admin costs

Example Implementation Costs (With Trading)



	GSA A	GSA B	Benefits from Trading
No Trading	$395	$520	
With Trading	$405	$405	
Difference in Cost	+$10	-$115	$105 (**$52.50/AF** each)
Cost After Trading $/AF of overdraft reduction	**$342.50**	**$467.50**	

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Demand Management Options – Next Time

- Demand management trading program options
  - Long term trading with limited restrictions
  - Avoiding undesirable results
  - Other market considerations
- Costs and benefits are not shared uniformly, analysis can help evaluate the:
  1. Cost tradeoff between projects and management actions
  2. Cost of alternative phase-in periods
  3. Economic fairness of alternative allotments

Current (2015 Land Use) Water Budget Summary

Madera Irrigation District

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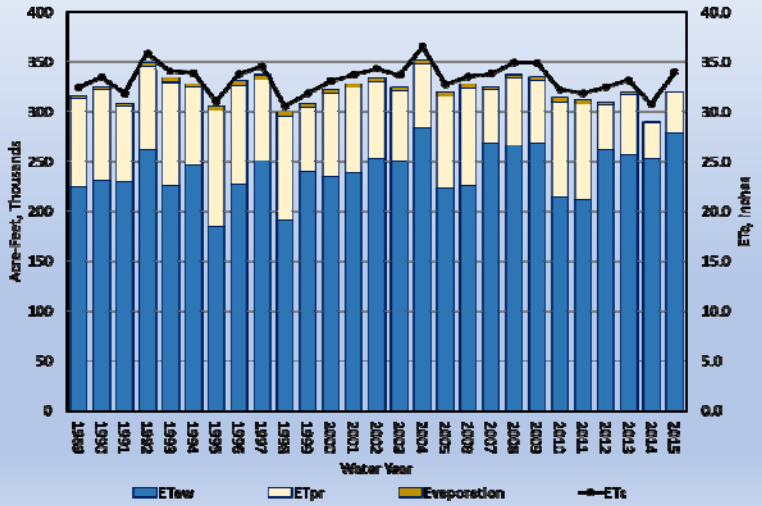
Madera ID 2015 Land Use and ET

Land Use	Area (acres)		Average ET, 1989-2014 (inches)		
	1989	2015	ET_c	ET_pr	ET_aw
Citrus and Subtropical	1,486	1,207	40.1	7.5	32.6
Corn	2,164	1,424	34.9	5.3	29.7
Grain and Hay Crops	1,164	2,634	19.6	5.6	14.0
Grapes	49,212	43,380	26.6	6.8	19.8
Idle	15,676	1,484	6.6	6.6	0.0
Miscellaneous Field Crops	6,048	43	30.7	5.7	25.0
Miscellaneous Truck Crops	498	2,570	30.4	5.5	24.8
Almonds	14,854	42,315	41.5	7.5	33.9
Miscellaneous Deciduous	4,663	2,614	32.5	7.2	25.3
Pistachios	2,039	6,034	36.9	7.1	29.8
Walnuts	585	704	33.8	7.5	26.4
Pasture and Alfalfa	9,743	2,223	33.5	6.7	26.7
Total	108,132	106,632			

Madera ID Current (2015 Land Use) Evapotranspiration



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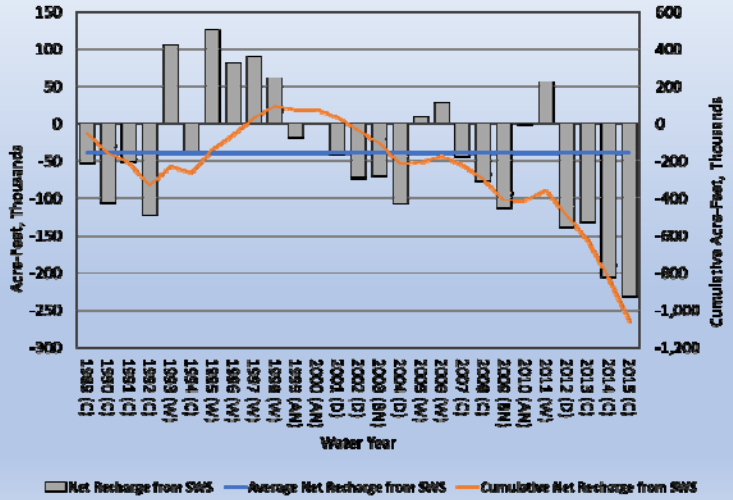
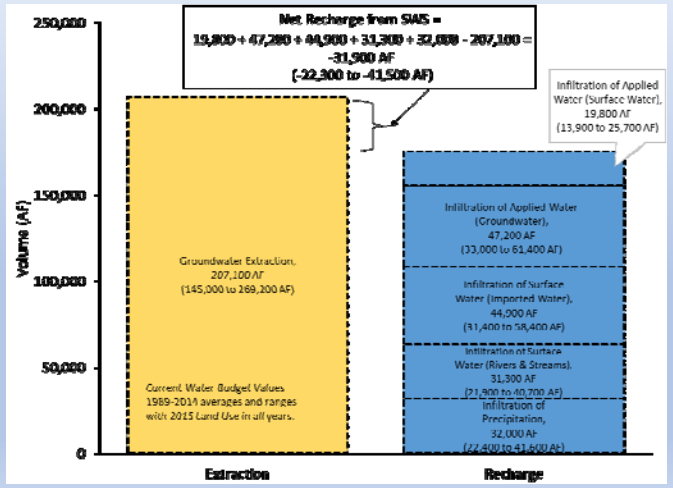
Madera ID Current (2015 Land Use) Net Recharge from SWS



Madera ID Current (2015 Land Use) Water Supply and Net Recharge



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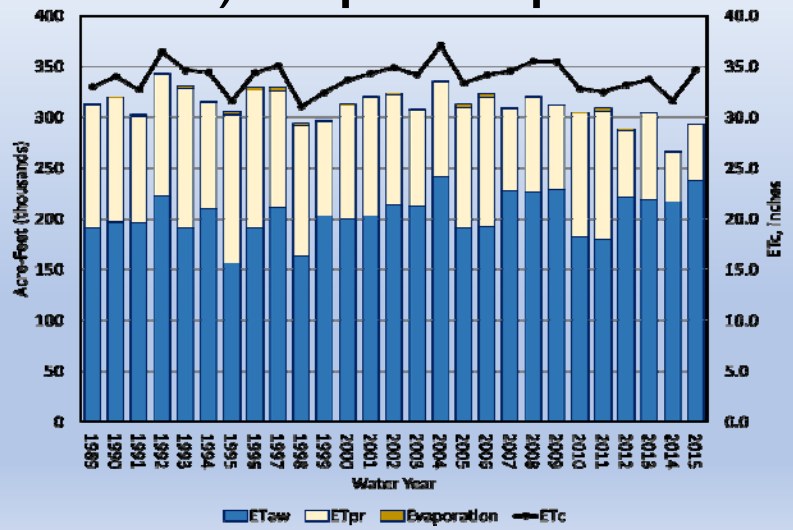
Current (2015 Land Use) Water Budget Summary
Madera County

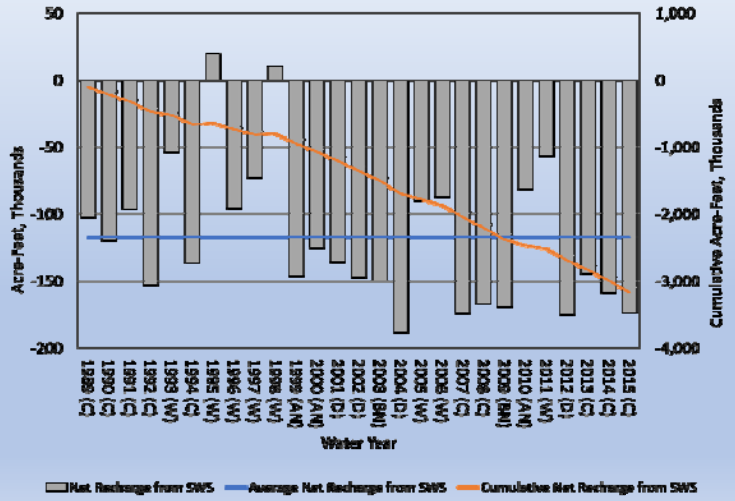
Madera County 2015 Land Use and ET

Land Use	Area (acres)		Average ET, 1989-2014 (inches)		
	1989	2015	ET_c	ET_pr	ET_aw
Citrus and Subtropical	1,646	1,632	40.1	7.5	32.6
Corn	2,532	5,368	34.9	5.1	29.8
Grain and Hay Crops	3,782	5,410	19.6	5.5	14.0
Grapes	15,246	16,417	26.6	6.8	19.8
Idle	14,068	2,420	6.5	6.5	0.0
Miscellaneous Field Crops	10,090	53	30.7	5.5	25.2
Miscellaneous Truck Crops	568	3,061	30.4	5.4	25.0
Almonds	4,411	27,399	41.5	7.6	33.9
Miscellaneous Deciduous	4,206	2,336	32.6	7.3	25.3
Pistachios	7,607	15,243	37.0	7.2	29.8
Walnuts	566	443	33.8	7.5	26.3
Pasture and Alfalfa	15,005	5,087	33.5	6.7	26.8
Total	79,728	84,869			

Madera County Current (2015 Land Use) Evapotranspiration



Madera County Current (2015 Land Use) Net Recharge from SWS



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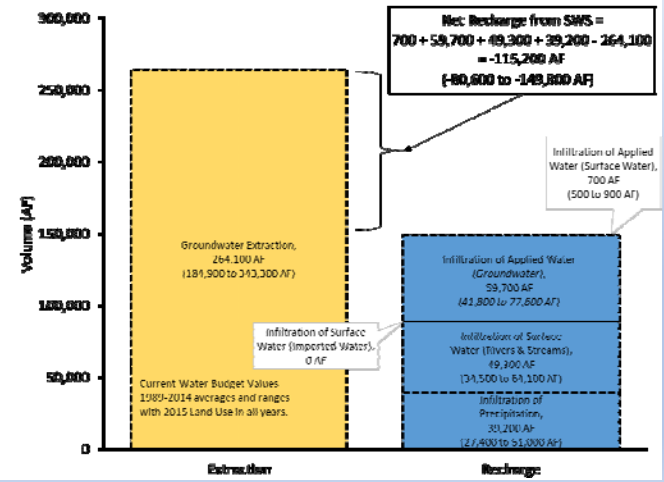
Madera County Current (2015 Land Use) Water Supply and Net Recharge



Current (2015 Land Use) Water Budget Summary

Root Creek Water District

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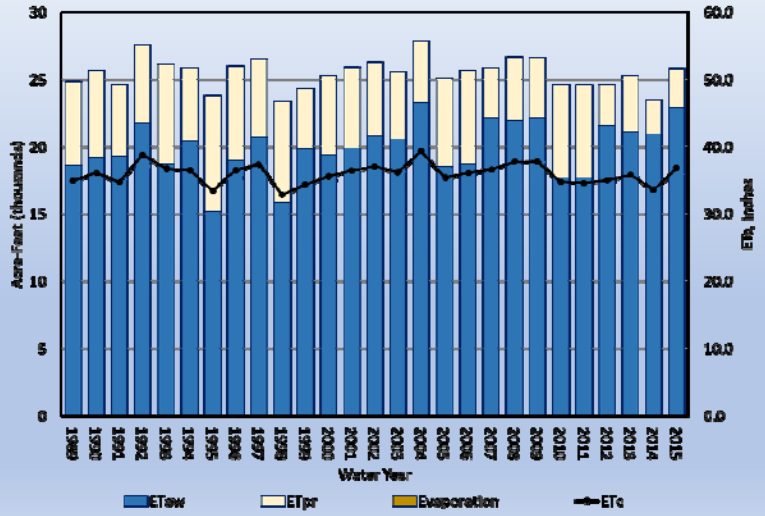
Root Creek WD 2015 Land Use and ET

Land Use	Area (acres)		Average ET, 1989-2014 (inches)		
	1989	2015	ET_c	ET_pr	ET_aw
Citrus and Subtropical	2,917	1,647	40.2	7.7	32.5
Corn	0	0	35.0	5.3	29.7
Grain and Hay Crops	146	539	19.6	5.7	13.9
Grapes	378	451	26.7	7.0	19.7
Idle	634	215	6.7	6.7	0.0
Miscellaneous Field Crops	43	1	30.8	5.7	25.2
Miscellaneous Truck Crops	5	632	30.5	5.6	24.9
Almonds	1,290	2,415	41.6	7.7	33.8
Miscellaneous Deciduous	32	19	32.6	7.4	25.2
Pistachios	1,767	2,210	37.0	7.3	29.7
Walnuts	20	9	33.9	7.7	26.2
Pasture and Alfalfa	647	82	33.6	6.8	26.8
Total	7,880	8,222			

Root Creek WD Current (2015 Land Use) Evapotranspiration



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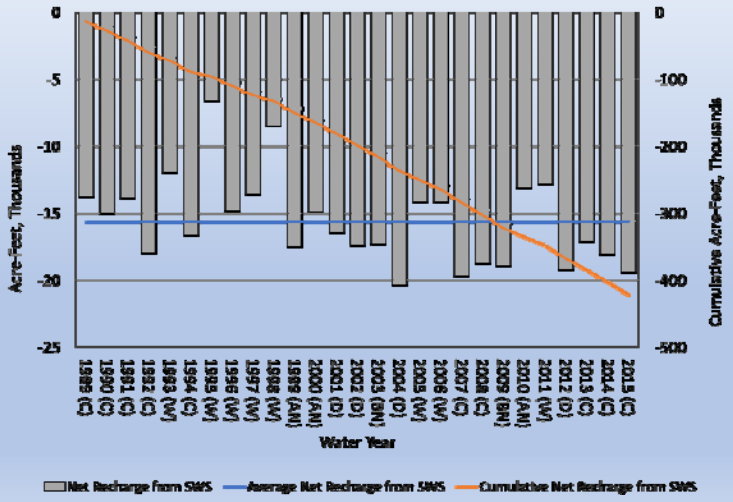
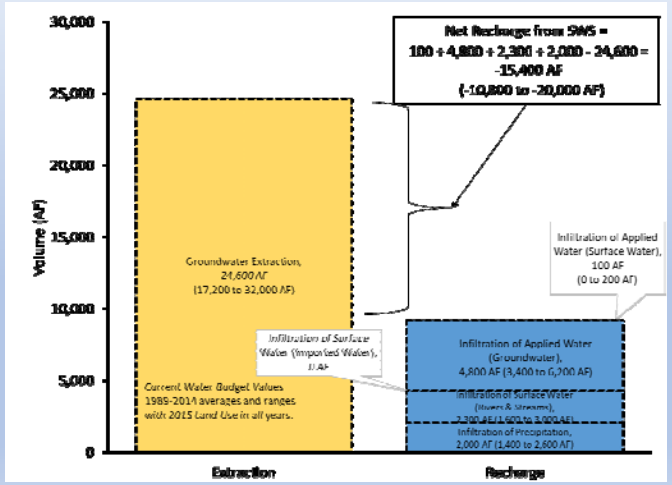
Root Creek WD Current (2015 Land Use) Net Recharge from SWS



Root Creek WD Current (2015 Land Use) Water Supply and Net Recharge



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Current (2015 Land Use) Water Budget Summary

Gravelly Ford Water District

Gravelly Ford WD 2015 Land Use and ET

Land Use	Area (acres)		Average ET, 1989-2014 (inches)		
	1989	2015	ET_c	ET_pr	ET_aw
Citrus and Subtropical	1	0	39.8	6.9	32.9
Corn	42	0	34.9	5.0	29.9
Grain and Hay Crops	60	21	19.6	5.1	14.4
Grapes	3,990	3,532	26.3	6.1	20.2
Idle	670	3	6.3	6.3	0.0
Miscellaneous Field Crops	573	89	30.4	5.4	25.1
Miscellaneous Truck Crops	146	833	30.1	5.2	24.9
Almonds	1,216	2,194	41.1	7.0	34.1
Miscellaneous Deciduous	110	0	32.2	6.6	25.6
Pistachios	0	823	36.6	6.5	30.2
Walnuts	0	0	33.6	6.8	26.8
Pasture and Alfalfa	752	6	33.2	6.3	26.9
Total	7,559	7,503			

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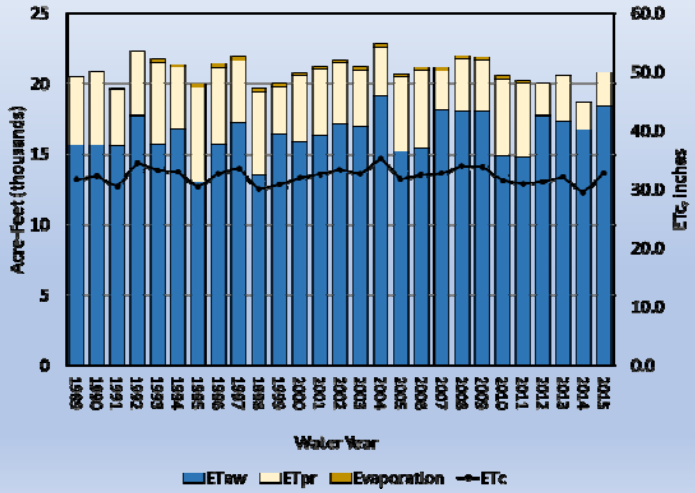
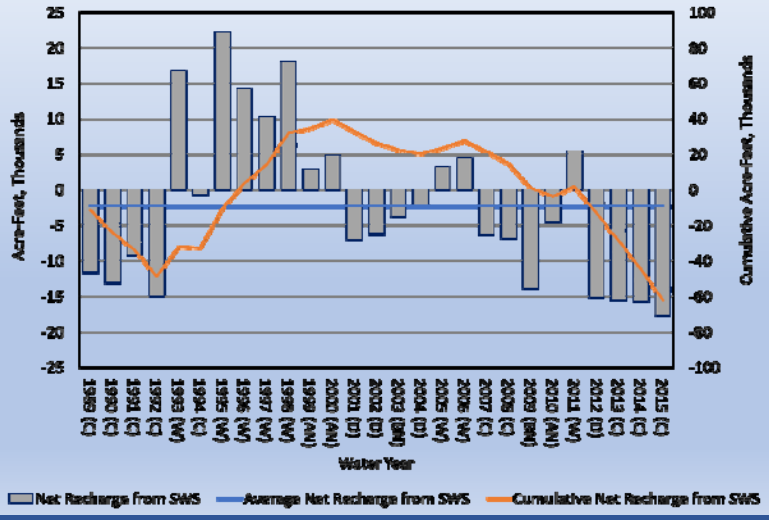
Gravelly Ford WD Current (2015 Land Use) Evapotranspiration



Gravelly Ford WD Current (2015 Land Use) Net Recharge from SWS



Madera Subbasin Second Technical Meeting
June 25, 2018
53

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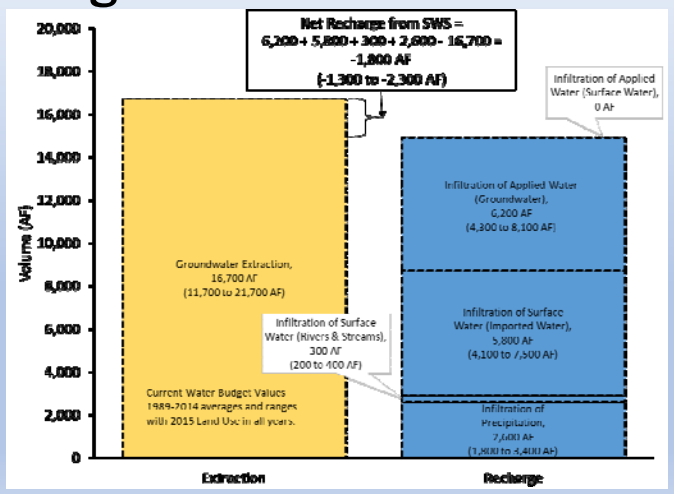
Gravelly Ford WD Current (2015 Land Use) Water Supply and Net Recharge



Madera Subbasin Second Technical Meeting
June 25, 2018
54

Current (2015 Land Use) Water Budget Summary

Madera Water District

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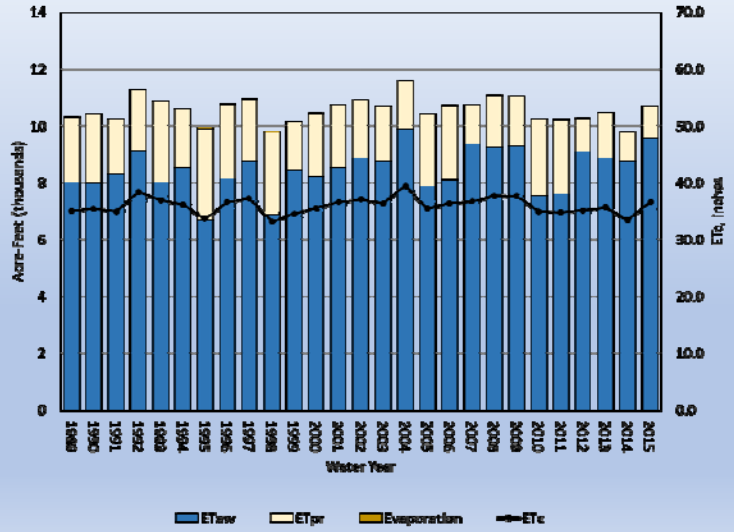
Madera WD 2015 Land Use and ET

Land Use	Area (acres)		Average ET, 1989-2014 (inches)		
	1989	2015	ET_c	ET_pr	ET_aw
Citrus and Subtropical	6	19	40.1	7.4	32.7
Corn	0	0	34.9	4.8	30.1
Grain and Hay Crops	12	89	19.6	5.3	14.3
Grapes	11	0	26.5	6.7	19.9
Idle	312	3	6.2	6.2	0.0
Miscellaneous Field Crops	30	0	30.6	5.2	25.3
Miscellaneous Truck Crops	0	289	30.3	5.2	25.1
Almonds	0	136	41.4	7.4	34.0
Miscellaneous Deciduous	36	34	32.5	7.1	25.3
Pistachios	2,727	2,788	36.9	7.0	29.9
Walnuts	0	0	33.8	7.4	26.4
Pasture and Alfalfa	269	39	33.5	6.5	27.0
Total	3,402	3,399			

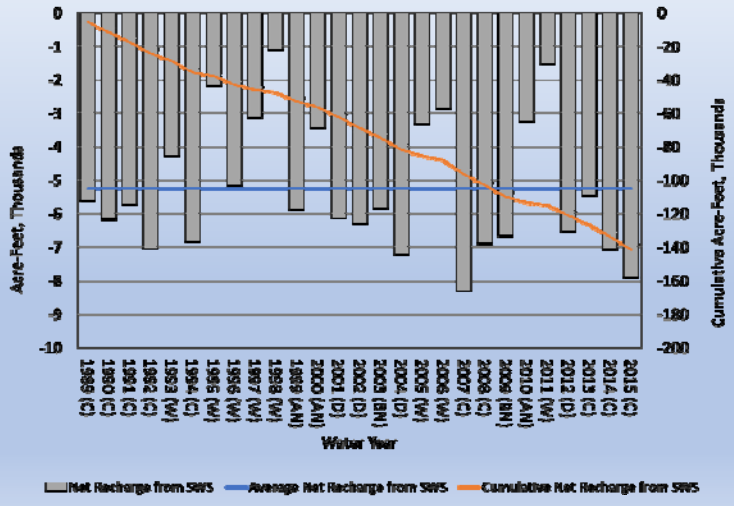
Madera WD Current (2015 Land Use) Evapotranspiration



Madera Subbasin Second Technical Meeting
June 25, 2018
57

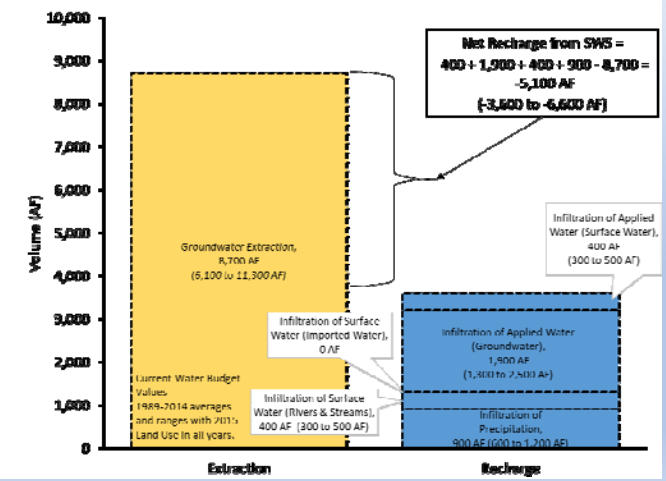
DRAFT

Madera WD Current (2015 Land Use) Net Recharge from SWS



Madera Subbasin Second Technical Meeting
June 25, 2018
58

Madera WD Current (2015 Land Use) Water Supply and Net Recharge



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Madera Subbasin Second Technical Meeting
June 25, 2018

59

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Current (2015 Land Use) Water Budget Summary

New Stone Water District

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Madera Subbasin Second Technical Meeting
June 25, 2018

60

New Stone WD 2015 Land Use and ET

Land Use	Area (acres)		Average ET, 1989-2014 (inches)		
	1989	2015	ET_c	ET_pr	ET_aw
Citrus and Subtropical	0	0	40.1	7.4	32.6
Corn	293	172	34.9	5.2	29.8
Grain and Hay Crops	93	26	19.6	5.5	14.1
Grapes	4	3,160	26.5	6.7	19.8
Idle	219	13	6.6	6.5	0.0
Miscellaneous Field Crops	20	223	30.7	5.6	25.1
Miscellaneous Truck Crops	0	85	30.3	5.4	24.9
Almonds	21	72	41.4	7.5	33.9
Miscellaneous Deciduous	0	0	32.5	7.1	25.4
Pistachios	28	82	36.9	7.0	29.8
Walnuts	0	0	33.8	7.4	26.4
Pasture and Alfalfa	3,152	119	33.4	6.7	26.8
Total	3,830	3,951			

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Madera Subbasin Second Technical Meeting
June 25, 2018

61

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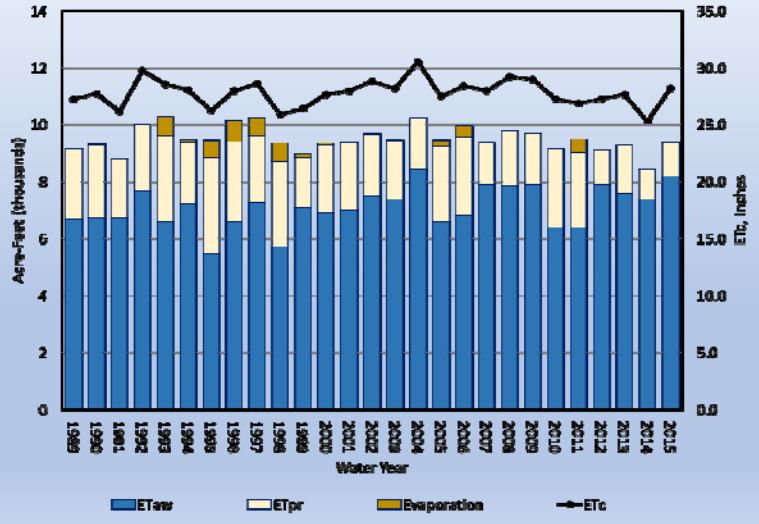
New Stone WD Current (2015 Land Use) Evapotranspiration



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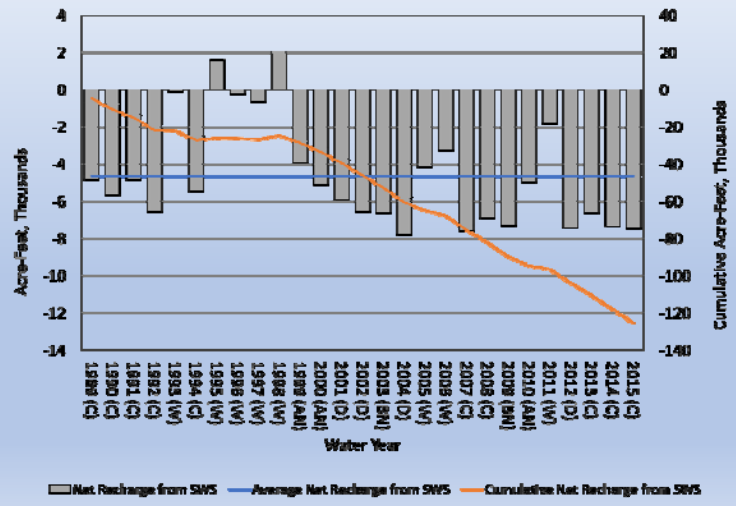
Madera Subbasin Second Technical Meeting
June 25, 2018

62

New Stone WD Current (2015 Land Use) Net Recharge from SWS



Madera Subbasin Second Technical Meeting
June 25, 2018
63

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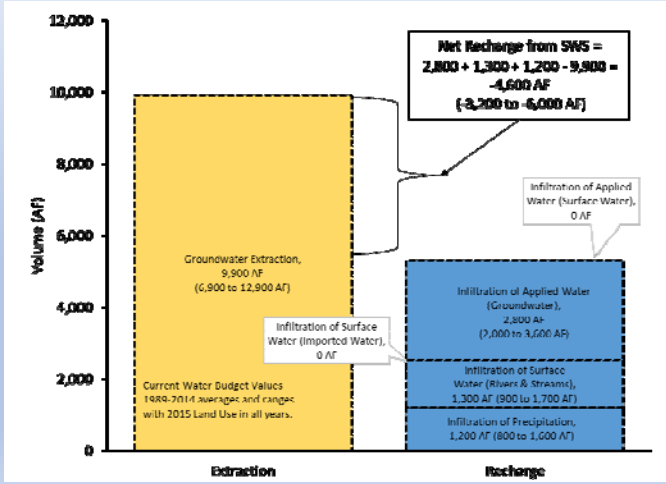
New Stone WD Current (2015 Land Use) Water Supply and Net Recharge



Madera Subbasin Second Technical Meeting
June 25, 2018
64

Current (2015 Land Use) Water Budget Summary

City of Madera

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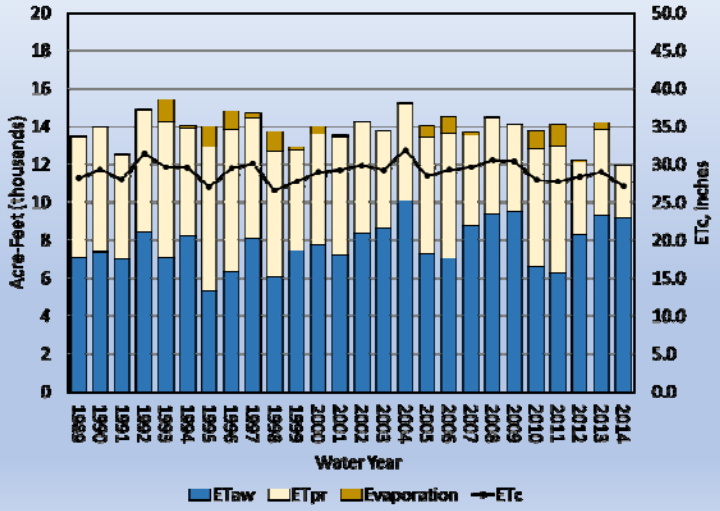
City of Madera 2015 Land Use and ET

Land Use	Area (acres)		Average ET, 1989-2014 (inches)		
	1989	2015	ET_c	ET_pr	ET_aw
Citrus and Subtropical	14	7	40.3	7.6	32.7
Corn	234	0	34.3	5.6	28.7
Grain and Hay Crops	291	398	7.7	7.7	0
Grapes	722	549	26.7	6.6	20
Idle	1,205	60	6.5	6.5	0
Miscellaneous Field Crops	386	0	30.9	6.4	24.5
Miscellaneous Truck Crops	0	11	30.4	5.2	25.2
Almonds	5	476	41.6	7.1	34.5
Miscellaneous Deciduous	26	50	30.4	8.3	22.1
Pistachios	1	8	32.3	7.5	24.8
Walnuts	9	1	33.9	7.2	26.7
Pasture and Alfalfa	500	25	38.6	7.5	31
Total	3,392	1,584			

City of Madera Current (2015 Land Use) Evapotranspiration

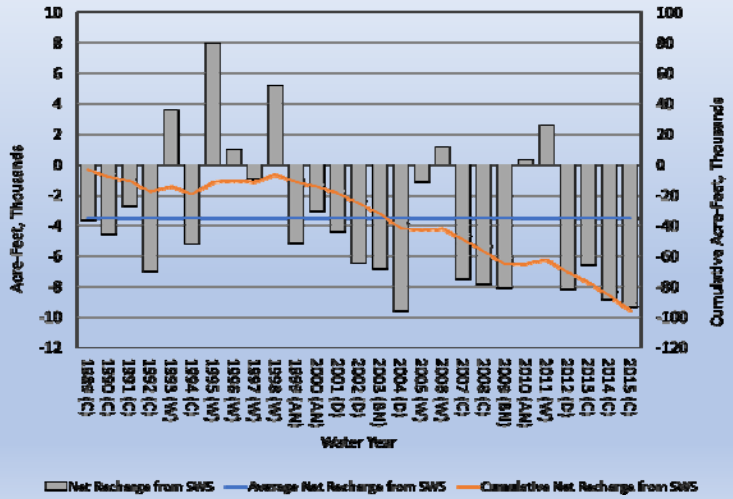


Madera Subbasin Second Technical Meeting
June 25, 2018

67

DRAFT

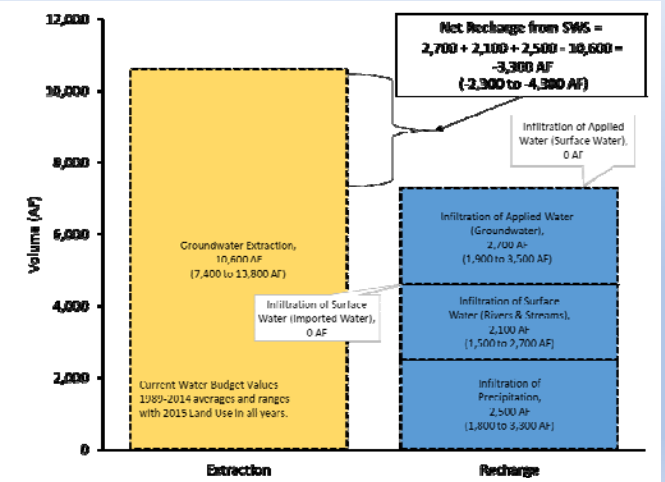
City of Madera Current (2015 Land Use) Net Recharge from SWS



Madera Subbasin Second Technical Meeting
June 25, 2018

68

City of Madera Current (2015 Land Use) Water Supply and Net Recharge



Madera Subbasin Second Technical Meeting
June 25, 2018
69

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Summary

- Madera Subbasin PRELIMINARY overdraft estimates
  - Current: -161,100 AF/yr (-128,900 to -193,300 AF/yr)
  - Will be refined through additional technical work and modeling
- Overdraft volumes vary across the basin
- Supply augmentation projects alone are unlikely to fill the gap
  - Limited potential projects
  - Questionable feasibility and timing
  - Affordability challenges
- Demand management program to reduce groundwater extraction to fill the gap
  - Scale up or down, over time, depending on cost-effective supply augmentation projects
  - Ensure subbasin meets sustainable yield
    - One key GSP evaluation criteria (Article 6. § 355.4.b.(5))

Madera Subbasin Second Technical Meeting
June 25, 2018
70

Next Steps–2018

Tentative Dates	Meeting Type	Time & Address	Major Topics	GSP Milestones (GSA Decisions needed)
6/25/2018	Public Round Table/Coordination #2 Committee	1-4pm Madera Farm Bureau	GSA water budgets, projects and management actions, management actions and guidelines	Management Areas
8/16/2018	Public/Technical Workshop #3	TBD	Basin Setting, HCM, GW Conditions, Sustainability Goals, Undesirable Results, Minimum Thresholds, Water Markets	No Decisions Workshop only
9/20/2018	Public Round Table/Coordination #3 and 4 Committee	TBD	Discuss Basin Setting, HCM and GW Conditions, Discuss and Approve Sustainability Goals, Undesirable Results, Minimum Thresholds, Water Markets, Define Coordination elements for Madera Subbasin Coordination Committee	Affirm no management areas Conceptual Definition Undesirable Results,
Early Oct	Adjacent Subbasin Meeting#1— Kings/Delta-Mendota/Chowchilla	TBD	Technical approach/framework, boundary conditions	
10/18/2018	Public/Technical Workshop #4	TBD	GW Model--Selection and Refinement, GDEs, interbasin technical framework, projects and management actions Madera Coordination Committee Agreement provisions approved (without data components)	Madera Coordination Committee agreements
11/15/2018	Public Round Table/Coordination Committee #5	TBD	Discuss interbasin technical framework, projects and management actions	Finalize minimum thresholds (pending approval from Adjacent interbasin coordination)

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Madera Subbasin Second Technical Meeting
June 25, 2018

71

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Discussion

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Madera Subbasin Second Technical Meeting
June 25, 2018

72